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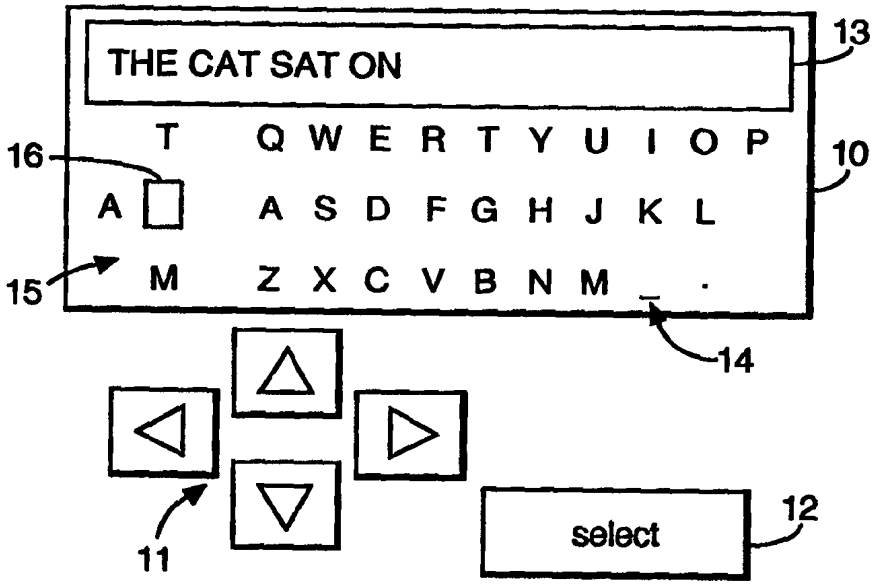
(54) **Title:** CHARACTER INPUT DEVICE

(57) **Abstract**

An input device for inputting key functions sequentially into an apparatus comprises a prediction module for predicting at least one most likely key function to be input next, at least one first key for inputting the key functions, a control module for controlling the function and labelling of the first keys in response to the prediction module to enable a user to use the first keys to input next the or each predicted most likely key functions, and second keys provided as an array arranged separately from an independent of the first keys and capable of inputting any of the key functions.



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CHARACTER INPUT DEVICE

The present invention generally relates to an input device for inputting instructions or data sequentially into an apparatus such as an information processing apparatus, which can include a display unit. An instruction is an input which causes the apparatus to carry out some function, such as to perform a calculation, justify text, make a telephone call, or print a document. A data item is an item (generally a single character such as a letter, numeral, or punctuation mark) which the apparatus is to use in such processing. The device combines the data items to form text, numerical data, etc. The functions of inputting data items and instructions may be combined, for example by displaying the data items as they are input to the device.

In modern information processing apparatus it is a necessary to provide a convenient user interface for the input of data items and instructions. Conventionally for computers and many other devices this is provided as a keyboard, operated in the conventional manner by touching or depressing keys each associated with a specified function. In the following, instructions and data items will be collectively referred to as "key functions".

The physical size of a keyboard is dictated by the number of individual keys required, (about 50 on a typewriter, over 100 on a typical computer) and also by the physical size of the individual keys, which is in turn dictated by ergonomic considerations, in particular the size of human fingers. Not all devices can allow for the provision of a keyboard of this size. For example, in personal digital assistants (PDAs), pagers, mobile phones, and remote control devices, the physical size of the device limits the number of keys that can be accommodated on its surface. It is therefore necessary to arrange that the required functions can be activated using a

smaller number of keys. This generally requires any given key to have several functions – most functions then require a sequence of several keystrokes, instead of a single keystroke, to activate them. The fewer the number of keys, the more difficult for a user to learn and operate such systems.

Many attempts have been made to provide ergonomic keyboard arrangements using a minimal number of keys. In some of these, a cursor is moved over a graphical representation of a conventional keyboard displayed on a screen, using a "joystick", "mouse" or "arrow keys". The individual key required can then be selected by a single action when the cursor is over the representation of the required key. Examples of this arrangement are to be found in International Patent specification WO97/35413 (Nokia). The well-known "Windows" computer operating system marketed by Microsoft Corporation also employs this principle for some functions.

However, for entry of large amounts of data such as text such an arrangement is cumbersome as the cursor must be moved and positioned accurately over each character required in turn. Conventional "QWERTY" typewriter layouts (so-called from the order of the first six keys on the first row), or alphabetical layouts, are not convenient for such data entry as relatively large distances need to be travelled by the cursor between each character and the next. In particular, the "QWERTY" layout was designed for data entry not by a single cursor, but by the user's ten fingers.

Various proposals exist in which the size of the keyboard is reduced by reducing the number of keys, or key representations. In these systems the user interface is arranged to respond to each input by reconfiguring itself in anticipation of the next action required, such that the action or actions most likely to be required

require the minimum action. For text entry, linguistic analysis can be used to select the likely next character. For example, United States patent 5128672 (Kaehler) discloses a 19-key keyboard in which the keyboard has twelve possible configurations. Each keystroke, as well as causing the required data entry, causes the keyboard to either remain in the same configuration, or change into one of the other eleven, such that the key functions most likely to be selected next are offered to the user. If the user requires a different key function he can carry out additional keystrokes to locate a configuration which allows that key function. However, this system is difficult to use as activating a given key may cause any one of twelve different key functions, depending on the configuration selected by the action of the previous key.

Other proposals, such as International Patent specification WO97/04580 (Pacific Communication Sciences) have several different functions permanently allocated to each key. In this specification, the most likely of these functions (as determined by linguistic or other analysis of previous keystrokes) is made available to the user by simply activating the key, whilst additional keystrokes are required to activate the less likely ones.

In all of these systems there is a requirement to learn the configuration and dynamic behaviour of the input device, and to take multiple actions when rare sequences of key functions are required. A fixed layout is much easier to learn, (and many millions of people are already familiar with the "QWERTY" layout), but requires on average greater movement of a cursor from one character to the next than a dynamic one.

According to the invention there is provided an input device for inputting key functions sequentially into an apparatus, the key functions being instructions or data items, the input device comprising:

display means for displaying the key functions;

the display means comprising means for displaying a first array arranged to display one or more key functions selected from a plurality of key functions;

key means for inputting key functions selected from the functions displayed in the array;

processing means for interpreting the operation of the key means;

prediction means responsive to the processing means for predicting at least one most likely key function to be input next;

control means responsive to the prediction means for controlling the display means to select the key function or functions to be displayed in the first array, and to control the functioning of the key means in accordance with the displayed functions;

characterised in that the display means comprises means for displaying a second array arranged to display all of the plurality of key functions, the key means being arranged to input key functions selected from either array.

In a second aspect, the invention comprises a method of inputting key functions sequentially into an apparatus, the key functions being instructions or data items, the method comprising:

displaying a first array of one or more key functions selected from a plurality of key functions;

selecting key functions from the functions displayed in the array, by operation of key means;

interpreting the operation of the key means to input the selected key function;

predicting at least one most likely key function to be input following the selected key function;

modifying the first array to display the key function or functions so predicted, and modifying the functioning of the key means in accordance with the newly displayed functions;

characterised in that the second array is arranged to display all of the plurality of key functions, and that key functions can be selected from either array.

By predicting the most likely key function or functions next to be input, the arrangement of keys presented to a user can be such that the first array of keys provides for input of any of a predetermined number of most likely next key functions, such as the three most likely. The array may consist of a single key, to offer only the most likely such key function. The second, fixed, array of keys allows for conventional input. The user is thus presented with easily identifiable keys to input the most likely key function or functions. Users familiar with the standard keyboard layout of the second array may use the second array for such input, if they prefer. If the prediction is not correct, the user will have to use the second, conventional, array of keys. However, so long as the prediction is reasonably accurate, the number of times a user has to resort to using the conventional array of keys should be significantly reduced.

The first array of keys is preferably arranged in a group thus making them more easily identifiable to a user. The group can be arranged at any point separate from the conventionally arrayed keys e.g. to one side, or in the middle.

The key means can comprise conventional keys the labelling of which can be changed e.g. by incorporating an LCD within the keycap. Alternatively a screen displaying key labels representing the two arrays may be used. This allows more flexibility in the layout of the key labels, and the number and arrangement of the predictive key labels can be changed during use, for example in response to each input. It is possible for the two arrays to be displayed separately, the first array being displayed first, with means to switch to the second array if required, for example if the required key function is not one of those predicted, and therefore not present in the first array.

The display may be of the touch-sensitive type, in which the presence of a stylus, fingertip, or other object, on a region of the display device is detected and the function corresponding to the key label currently represented in that region is activated.

In an embodiment which is particularly suited to small devices e.g. PDAs, mobile phones, remote controls, games consoles, and pagers, the first and second arrays are displayed in conjunction with a cursor or other marker which can be moved in relation to the arrays. The key means comprises a pointing means, such as direction keys arranged to move the cursor either up, down, left or right. Alternatively the pointing means may be a position transducer such as a tracker ball, mouse or joystick to allow the selection of one of the key labels, for example by moving a cursor across the display. This arrangement avoids the need to touch the display itself, thereby avoiding the ergonomic constraints on the physical size of the unit.

In one particular embodiment, after each input, the cursor returns to a default position and the predicted key labels of the first array are arranged adjacent

to the default position allowing the predicted key labels to be selected easily. Since the predictive key labels are closest to the cursor default position, fewer key operations are required in order to select them and it is rarely necessary for the cursor to traverse the complete conventional key layout in order to select a key label.

The prediction of the most likely key functions to be input next may be carried out based on the sequence of previously input key functions or based on any previously input key functions. This will depend on the nature of the data or instructions being input. Further, an initial input key function, or set of such functions, can be predicted based on predetermined knowledge of the most likely first key functions. Also, the prediction can be adaptively modified based on the degree of past success in predicting the actual input key functions.

The keys or key labels in the second array currently having the same functions as those in the first array may be identified by highlighting or the like. The highlighting may be different for each such key, corresponding to the position or some other characteristic of the corresponding key or key label in the first array.

The input device in accordance with the present invention can be incorporated within an apparatus e.g. a PDA, a mobile phone, a pager, a calculator or a public information kiosk, or it can be provided separately e.g. as a remote control, games console, or a keyboard for a computer.

Embodiments of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a schematic drawing of apparatus incorporating the input device in accordance with an embodiment of the present invention,

Figure 2 is a flow diagram illustrating the operation of the input device in accordance with an embodiment of the present invention,

Figure 3 illustrates a user interface of an input device in accordance with a first embodiment of the present invention,

Figure 4 illustrates a user interface of an input device in accordance with a second embodiment of the present invention,

Figure 5 illustrates a user interface of a public information kiosk in accordance with a third embodiment of the present invention,

Figure 6 illustrates an input device in accordance with an embodiment of the present invention incorporated in a pager,

Figure 7 illustrates an input device in accordance with an embodiment of the present invention incorporated in a public information kiosk,

Referring now to Figure 1, an apparatus incorporating the input device in accordance with an embodiment of the present invention is illustrated in which the input device 5 comprises a key input detection module 1 for detecting the selection of a key and thus for generating an input key function, a prediction module 3 for receiving the input key function and for predicting the most likely next key functions, a control module 4 for receiving the predicted key functions and for outputting instructions to a key labelling module 2 to modify the labelling of the keys to reflect the prediction, and to control the functionality of the key input detection module 1 to correspond to the modified labelling of the keys.

Key functions input by the key input detection module 3 are also passed to a display 6 for displaying information as a result of the input instructions, or for displaying the input data. Further, the input key functions are passed to a processing module 7 for the implementation of the input instructions or for the processing of the input data.

Although in Figure 1 the input device 5 is illustrated as being separate from the display 6 and the processing module 7, the functions of the input device 5 can also be carried out by the display 6 and the processing module 7. For example, the display can comprise a common display for displaying both the input data and the keys for inputting the data. For example, the display can comprise a touch sensitive display, or a portion of the display can be reserved for displaying virtual keys, selectable by a cursor. Further, the prediction carried out within the input device and the control of the labelling of the displayed keys can be carried out by a suitably programmed common processor.

Figure 2 is a flow diagram illustrating the operation of the input device of an embodiment of the present invention wherein in step S1 an initial input is predicted based on a knowledge of the most likely initial input. For example, if text is being entered and thus the data comprise characters, the prediction can be carried out based on a knowledge of the most likely characters which start a sentence taking into account the application to which the input device is applied.

In step S2 the labelling of the keys is updated based on the prediction in step S1 and the input device will await the selection of a key in step S3. When a key has been selected, a key function is input corresponding to the selection in step S4. In step S5 the display output is updated based on the input key function and in step S6 a prediction of the next input is made based on previous inputs. The prediction can be based on the sequence of previous inputs e.g. for text input, or based on any previous inputs e.g. the input devices of Figure 5 to be described hereinafter.

Embodiments will now be described with reference to Figures 3, 4 and 5 for inputting text into apparatus.

Figure 3 illustrates a user interface of a first embodiment of the present invention comprising a display 10, cursor movement keys 11 for moving the cursor up, down, left and right, and a select key 12 for inputting the character once highlighted.

On the display 10 a display region 13 is reserved for displaying the input text. A region 14 is reserved for displaying selectable characters, which in this embodiment are arranged in the conventional "QWERTY" keyboard layout. To one side of the conventional key layout area 14 there is provided a predicted key area 15 adjacent to a cursor default position in which the cursor 16 is illustrated as being positioned.

The display device can be of any suitable type. For example, it may be comprise an array of liquid crystal devices (LCDs) or a pixel-addressable array. These may be arranged as a number of sub-arrays, each arranged to display an individual character, as is common in small electronic devices. In the embodiment illustrated in Figure 3, an array 10 of such sub-arrays is shown, wherein there are four rows of such sub-arrays, the top row 13 being used to display the text being generated, whilst the other three rows 14 display the key labels. Other display types may be used, for example cathode ray tubes, which can generate any desired display at the cost of greater complexity.

In the illustration of Figure 3 a previous input has recently been made and thus the cursor 16 has returned to its default position adjacent to the predicted key region 15. In the "predicted key" region 15 three letters T, A and M have been predicted as being the three most likely next inputs. If the prediction is correct, a user can move the cursor 16 using the cursor movement keys 11 to highlight the desired input character. If the predicted characters are not correct, a user can move

the cursor 16 to the conventional key area 14 to highlight any desired character. Once the desired character has been highlighted, operation of the select key 12 causes the character to be input and displayed in the display area 13. The cursor 16 then returns to its default position as shown in Figure 3 and the predicted key area will change to illustrate the predicted next most likely inputs.

As can be seen in this embodiment, by providing the predicted characters adjacent to the default position of the cursor 16, the number of key operations required to be performed by the user in order to move the cursor 16 to highlight the desired character is reduced if the prediction is accurate.

Although in Figure 3 the predicted key area 15 is illustrated as being on one side of the conventional key area 14, there is no limitation on the position.

Figure 4 illustrates an alternative embodiment to Figure 3 wherein the conventional key arrangement is divided into two parts 14a and 14b either side of the predicted key area 15.

Although the user interfaces of the input device of Figures 3 and 4 have been illustrated as having a conventional QWERTY keyboard layout for the fixed keys, the present invention is not limited to any particular fixed key arrangement. For example an alphabetical keyboard layout could be used or any other alphanumeric keyboard layout.

Figure 4 also illustrates an additional feature, which facilitates use of the device. In the embodiment of Figure 4, the fixed key layout area 14 is controlled to highlight the keys (currently T, A and M) within the second array 14 corresponding to the predicted inputs displayed in the first array 15. This allows a user having some familiarity with the standard keyboard layout to more readily identify the correct keys on the standard layout. In the preferred arrangement illustrated, the keys highlighted

in this way are each highlighted in a distinctive way. For example, the key "A", currently corresponding to the "left" key of the first array, may be highlighted in a distinctive colour, or with a distinctive mark such as a left chevron ("<"). This allows a user, familiar with the keyboard layout and expecting to key this character, to be given an indication, in the second array, that he can generate the character by moving the cursor 16 in the direction indicated, so that he can access the corresponding character in the first array 15.

Figure 5 illustrates an embodiment of the present invention suitable for use in an information kiosk for use by the public, which in this embodiment allows a user to select and view a particular model of a car from amongst a plurality of possible options.

In the embodiment of Figure 5 a user interface comprises a fixed array of keys 20, an adjacent set of predicted keys 21 and a display region 22. The keys 20 and 21 can either comprise keys within a touch sensitive screen of which the display region 22 can be a part, or they can comprise conventional mechanical keys the labelling of which can be changed e.g. by incorporation of a small LCD in each key.

In this embodiment each row of the keys represents different options, only one of which can be selected from each row. Selection of one key from each row comprises a group or set of inputs defining the desired image to be viewed on the display region 22.

Initially before a user makes any selection the predicted keys 21 can display the most commonly predicted selection, which in this example comprises a "GL" model with blue paint and a grey seat trim. As soon as a user makes a selection of any one of the fixed keys 20, the predicted keys will change to reflect the selected key and the predicted combination of keys. For example, if a "sport" model is

selected, based on known customer preferences, the predicted keys could change to predict red paint and leather trim since these are the most likely combination. If a user agrees to the prediction, in order to view the car the user can select the predicted red paint and leather trim keys in order for the selection to be displayed in the display region 22.

In this embodiment the predicted keys display not only the past selection but also the predicted future selections and these will change as each selection is made. Thus the prediction is carried out based on any of the previous selections.

Figure 6 illustrates the incorporation of the user interface of an input device of Figures 3 or 4 in a pager.

Figure 7 illustrates the incorporation of the user interface of Figures 3, 4 or 5 in a public information kiosk.

Although the present invention has been described herein with reference to specific embodiments, the present invention is not limited to these specific embodiments and modifications falling within the scope of the present invention will be apparent to a skilled person in the art.

CLAIMS:

1. An input device for inputting key functions sequentially into an apparatus, the key functions being instructions or data items, the input device comprising:

display means (10) for displaying the key functions;

the display means comprising means for displaying a first array (15) arranged to display one or more key functions selected from a plurality of key functions;

key means (11) for inputting key functions selected from the functions displayed in the array (15);

processing means (1) for interpreting the operation of the key means;

prediction means (3) responsive to the processing means for predicting at least one most likely key function to be input next;

control means (6,7) responsive to the prediction means for controlling the display means (10) to select the key function or functions to be displayed in the first array (15), and to control the functioning of the key means (11) in accordance with the displayed functions;

characterised in that the display means (10) comprises means for displaying a second array (14) arranged to display all of the plurality of key functions, the key means (11) being arranged to input key functions selected from either array.

2. An input device according to claim 1 wherein said first and second arrays (14,15) each comprise a plurality of key elements arranged as a group.

3. An input device according to claim 1 or claim 2 wherein said key means (11) comprises a plurality of touch responsive keys.

4. An input device according to claim 1 or claim 2 wherein said display means (10) comprises output means for visibly displaying an array of key input labels (14, 15), the key means (11,12) being arranged to select one of said key input labels to input a corresponding key function.

5. An input device according to claim 4 wherein said key means (11) control pointer display means (6) for causing the display means (10) to display a cursor (16) moveable to select one of said key input labels (14, 15).

6. An input device according to claim 4 or claim 5 wherein said key means comprise cursor movement means (11) for moving a cursor (16) visibly output on said display means (10), said second array comprises a plurality of key input labels (14) visibly output on said display means (10), said first array comprises a plurality of key input labels (15) visibly output on said display means adjacent to a default visible position for said cursor (16), and said cursor movement means (11) is operable to move said cursor (16) to select any of said first or second key input labels (14,15) to input the corresponding key function and to return said cursor (16) to said default visible position after the input of a key function.

7. An input device according to claim 6 wherein said key means comprises at least one cursor movement key (11) and a selection key (12) for input of the key function corresponding to the selected key input label.

8. An input device according to any one of claims 4 to 7 wherein said control means (4) is arranged to set the number of key input labels in the first array (15) in dependence upon the number of most likely key functions to be input next and which have a likelihood greater than a predetermined threshold.

9. An input device according to any preceding claim wherein the key means comprises first and second arrays of keys, and said control means (4) is adapted to label the members of said first array of keys in accordance with a corresponding plurality of the most likely key functions to be input next, and to set an input function of each said member of the first array accordingly.

10. An input device according to any preceding claim wherein said prediction means (3) is adapted to perform the prediction based on the sequence of previously input key functions.

11. An input device according to any preceding claim wherein said control means (4) is further adapted to modify the labelling of said second array (14) in response to the prediction made by said prediction means to cause identification of members of said second array of key means corresponding to the or each key function corresponding to a member of the first array (15).

12. A device according to claim 11, the control means (4) being arranged to modify the labelling of said second array (14) such that each member of the second array so identified is uniquely identified with the corresponding member of the first array (15).

13. A method of inputting key functions sequentially into an apparatus, the key functions being instructions or data items, the method comprising:

displaying a first array (15) of one or more key functions selected from a plurality of key functions;

selecting key functions from the functions displayed in the array (15), by operation of key means;

interpreting the operation of the key means to input the selected key function;

predicting at least one most likely key function to be input following the selected key function;

modifying the first array to display the key function or functions so predicted, and modifying the functioning of the key means (11) in accordance with the newly displayed functions;

characterised in that the second array (14) is arranged to display all of the plurality of key functions, and that key functions can be selected from either array.

14. A method according to claim 13 wherein said first and second arrays (14,15) comprise a plurality of key elements arranged as a group.

15. A method according to claim 13 or claim 14 wherein the arrays of key input labels (14, 15), are displayed for selection by key means (11) to input a corresponding key function.

16. A method according to claim 15 wherein a cursor (16) is displayed, the cursor being moved under the control of the key means (11) to select one of said key input labels (14, 15).

17. A method according to claim 16 wherein said cursor (16) is operable under the control of cursor movement means (11) to select any of said first or second key input labels (14,15) to input the corresponding key function, and returns to a default position adjacent the first array (15) after the input of a key function.

18. A method according to claim 17 wherein input of the key function corresponding to the selected key input label is activated by operation of a selection key (12) associated with the cursor movement means.

19. A method according to any one of claims 15 to 18 wherein the number of key input labels in the first array (15) is set in dependence upon the number of most likely key functions to be input next and which have a likelihood greater than a predetermined threshold.

20. A method according to any of claims 13 to 19 wherein said prediction is performed according to the sequence of previously input key functions.

21. A method according to any of claims 13 to 20 wherein said control means (4) is further adapted to modify the labelling of said second array (14) in response to the prediction by said prediction means to cause identification of members of said second array of key means (14) corresponding to the or each key function corresponding to a member of the first array (15).

18. 22. A method according to claim 21, wherein labelling of said second array (14) is modified such that each member of the second array so identified is uniquely identified with the corresponding member of the first array (15).

Fig.1.

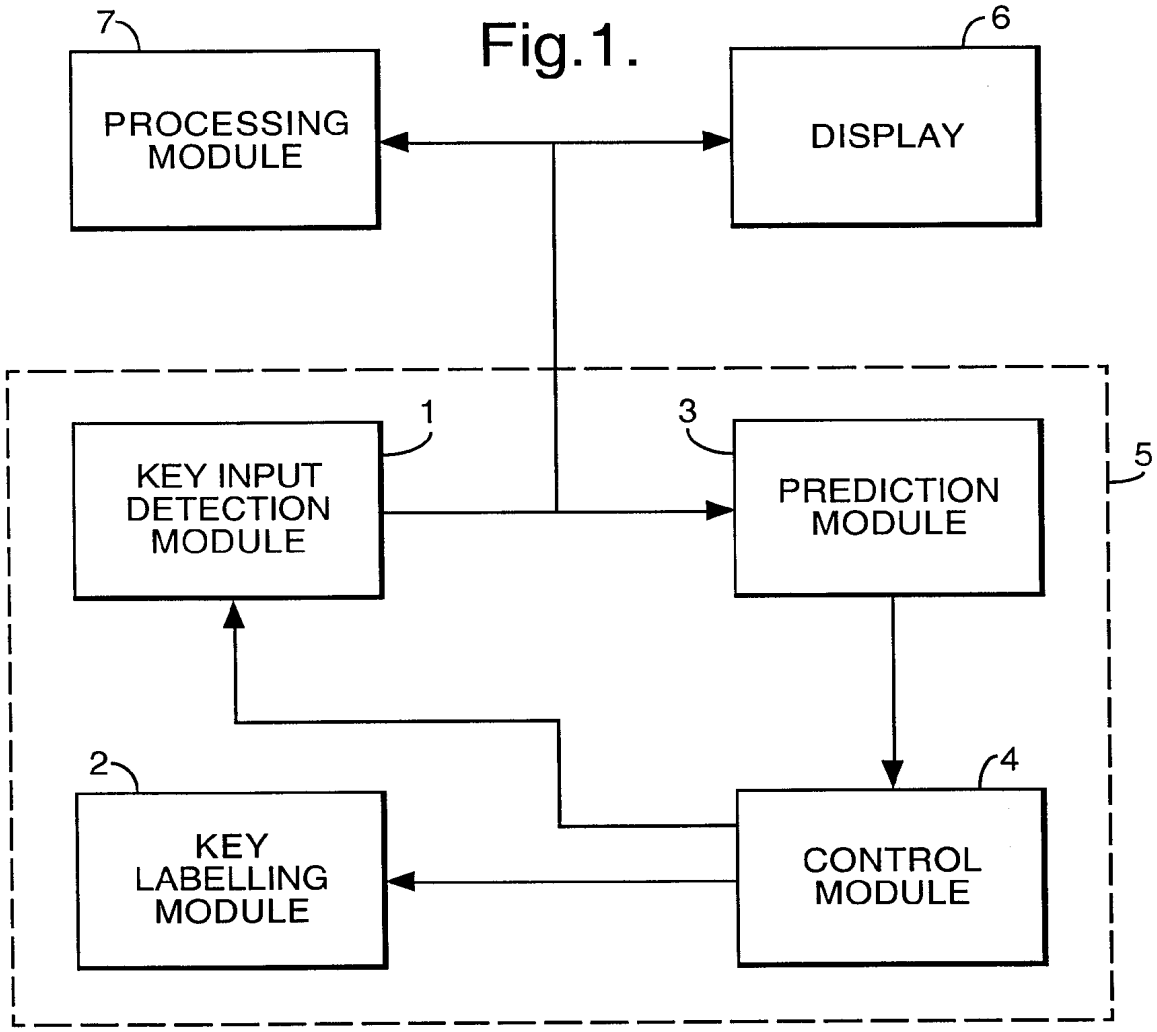

7
PROCESSING MODULE
6
DISPLAY
1
KEY INPUT DETECTION MODULE
3
PREDICTION MODULE
5
2
KEY LABELLING MODULE
4
CONTROL MODULE

Fig.5.

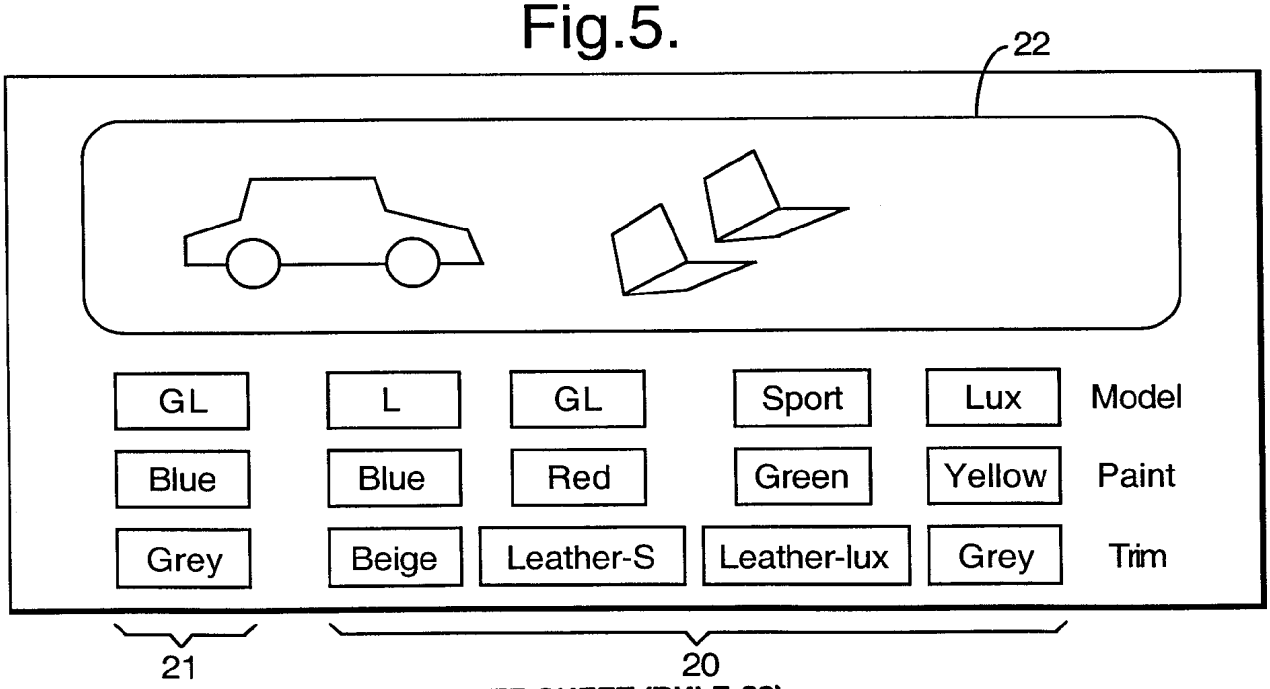

22
GL
L
GL
Sport
Lux
Model
Blue
Blue
Red
Green
Yellow
Paint
Grey
Beige
Leather-S
Leather-lux
Grey
Trim
21
20

Fig.2.

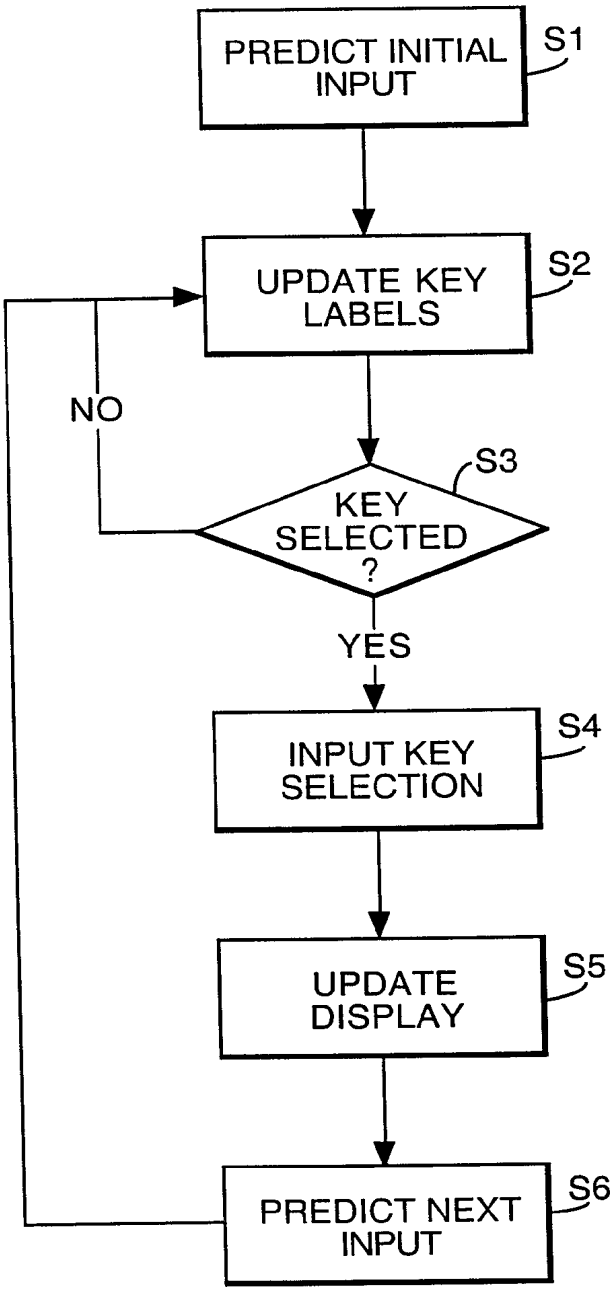

PREDICT INITIAL INPUT
S1
UPDATE KEY LABELS
S2
NO
KEY SELECTED ?
S3
YES
INPUT KEY SELECTION
S4
UPDATE DISPLAY
S5
PREDICT NEXT INPUT
S6

Fig.3.

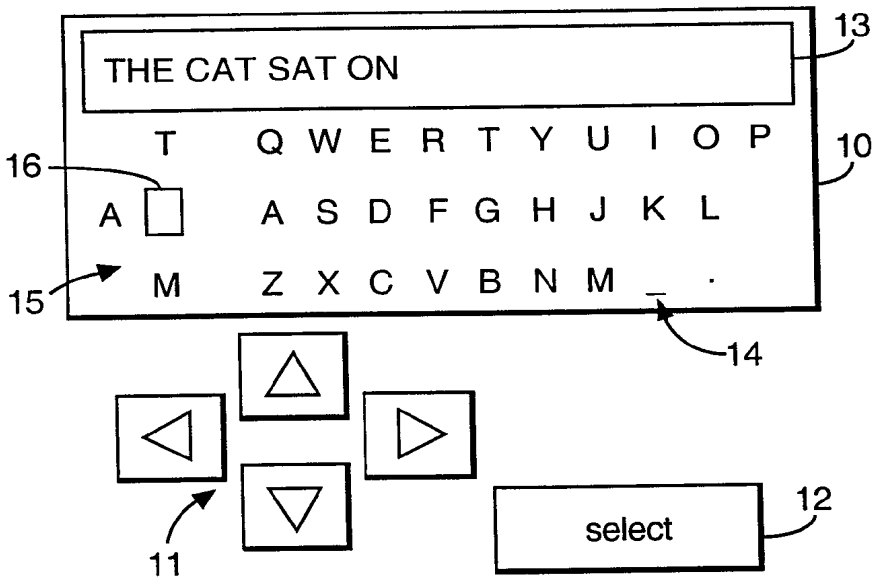

THE CAT SAT ON
13
T Q W E R T Y U I O P
10
16
A A S D F G H J K L
15
M Z X C V B N M _ .
14
11
select
12

Fig.4.

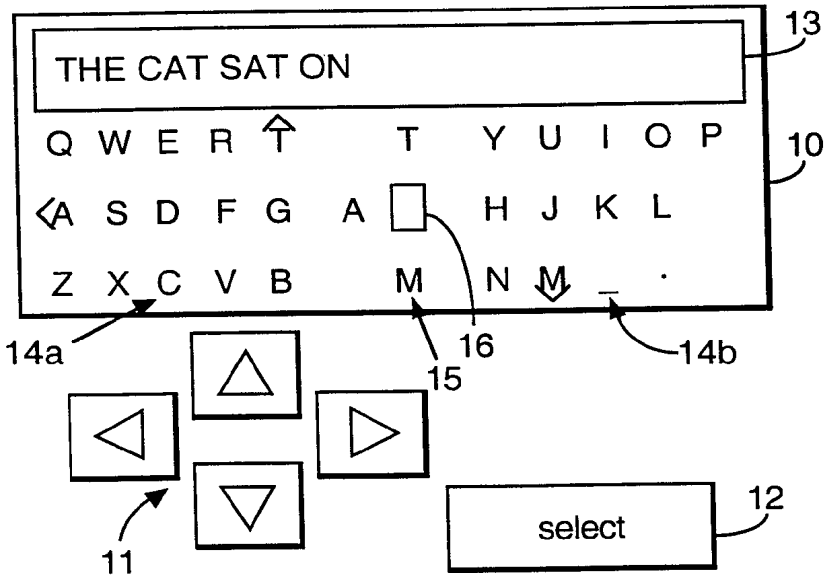

THE CAT SAT ON
13
Q W E R T T Y U I O P
10
A S D F G A H J K L
Z X C V B M N M _ .
14a
16
15
14b
11
select
12

Fig.6.

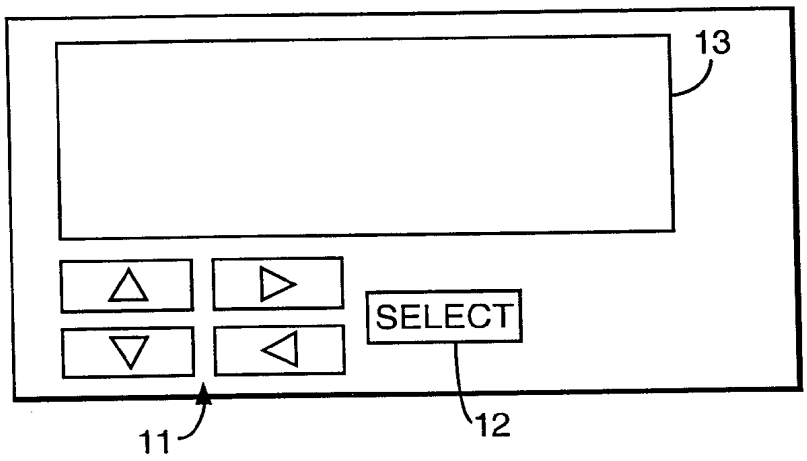
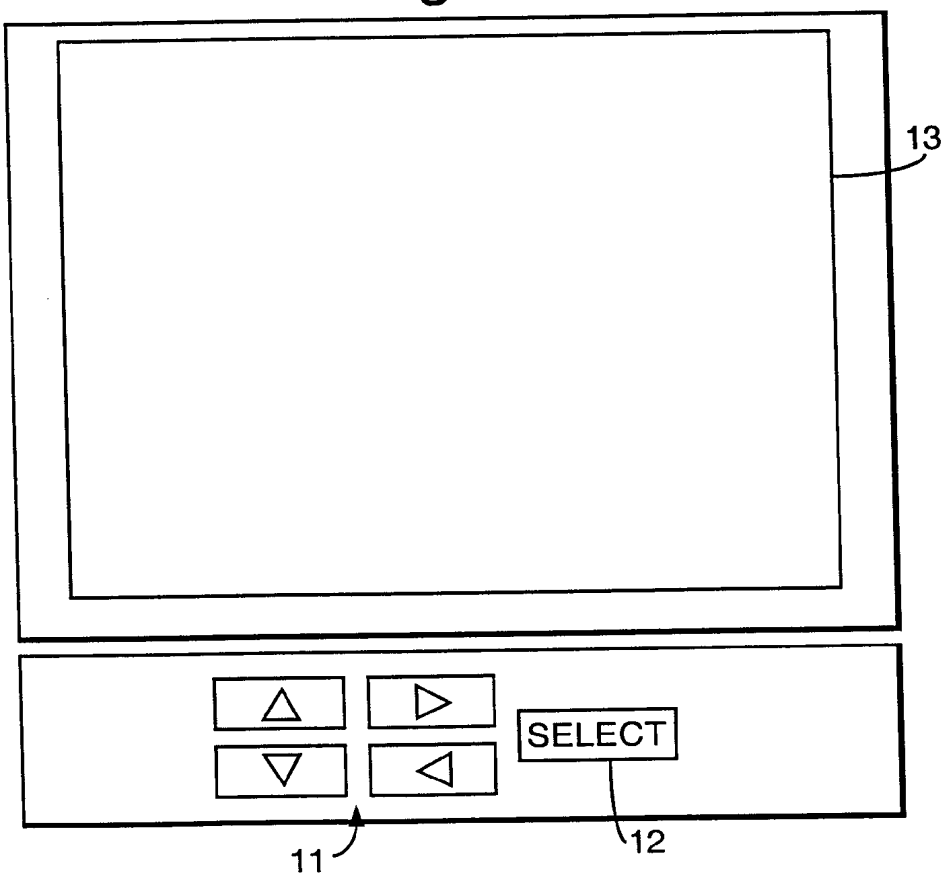


Fig.7.



INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 98/03502

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06F3/023

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06F H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 04580 A (PACIFIC COMM SCIENCES INC) 6 February 1997 cited in the application see abstract see page 1, line 25 - page 2, line 2 see page 6, line 16 - page 9, line 8 ---	1,2,4, 10,13, 14,20
A	US 5 128 672 A (KAEHLER EDWIN B) 7 July 1992 cited in the application see abstract see column 3, line 19 - line 48 see column 4, line 27 - line 53 --- -/--	5,10,11, 16,20,21

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 February 1999	23/02/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bailas, A

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INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/GB 98/03502

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 35413 A (NOKIA MOBILE PHONES LTD ;KIVELAE SEPPO (FI); HELLE SEPPO (FI); MOE) 25 September 1997 cited in the application see page 7, line 9 - line 28 ---	5-9, 16-19
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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US 5128672 A	07-07-1992	JP 5134797 A	01-06-1993
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